Air Quality Monitoring:

Sherwood Park

Jan-June 2008 **Interim Report**

Overview

A study was initiated to evaluate the concentration of fine particulate matter ($PM_{2.5}$) in Sherwood Park, east of Edmonton. The data presented in this interim report were collected between January and June 2008, at two monitoring sites. Overall, particulate concentrations at the two sites were comparable. Concentrations were generally higher during the winter months and for periods with low wind speeds. This is likely due to a larger semi-volatile fraction forming the sampled particles and/or lower mixing height during the winter months resulting in higher ground level concentrations.

Alberta has a 24-hour average[1] ambient air quality objective (AAAQO) of 30 $\mu g/m^3$. This objective was exceeded four times at Site A and one time at Site B. All exceedances occurred during the winter months. In addition, Alberta has ambient air quality *guidelines* used to assess local concerns and as a general performance indicator. The one-hour $PM_{2.5}$ *guideline* of 80 $\mu g/m^3$ was surpassed 12 times at Site A, and 5 times at Site B, although these elevated concentrations formed a very small fraction of the data collected at the two sites (0.4% of the data at Site A, and 0.2% of the data at Site B). The highest concentrations (greater than 80 $\mu g/m^3$) were observed for wind directions with a southerly component, but particulate concentrations did not show a well defined association with wind direction. Sampling at the two sites continued until December 2008, and a final report will be compiled.

[1] Averaged from midnight to midnight

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Monitoring method and location

The current study was designed to evaluate the concentration of fine particulate matter in Sherwood Park, east of Edmonton. Two Beta Attenuation Mass (BAM) monitors were used to perform the measurements. The BAM monitors provide one-hour average fine particulate matter concentrations as well as record meteorological parameters such as temperature, wind speed and direction. The samplers were installed at two monitoring sites (Figure 1). Site A is located in a residential area at an established air quality monitoring site (Strathcona Industrial Association's Sherwood Park station) west of Broadmoor Boulevard. Site B is located on the Canadian Broadcasting Corporation compound north of Wye road (Hwy 630); this site is south of a residential neighbourhood. The monitoring sites were located to be representative of the entire study area. In addition, the sites needed to be secure with a reliable power supply and accessible to monitoring staff. Data collection started in January 2008 and continued to the end of 2008.

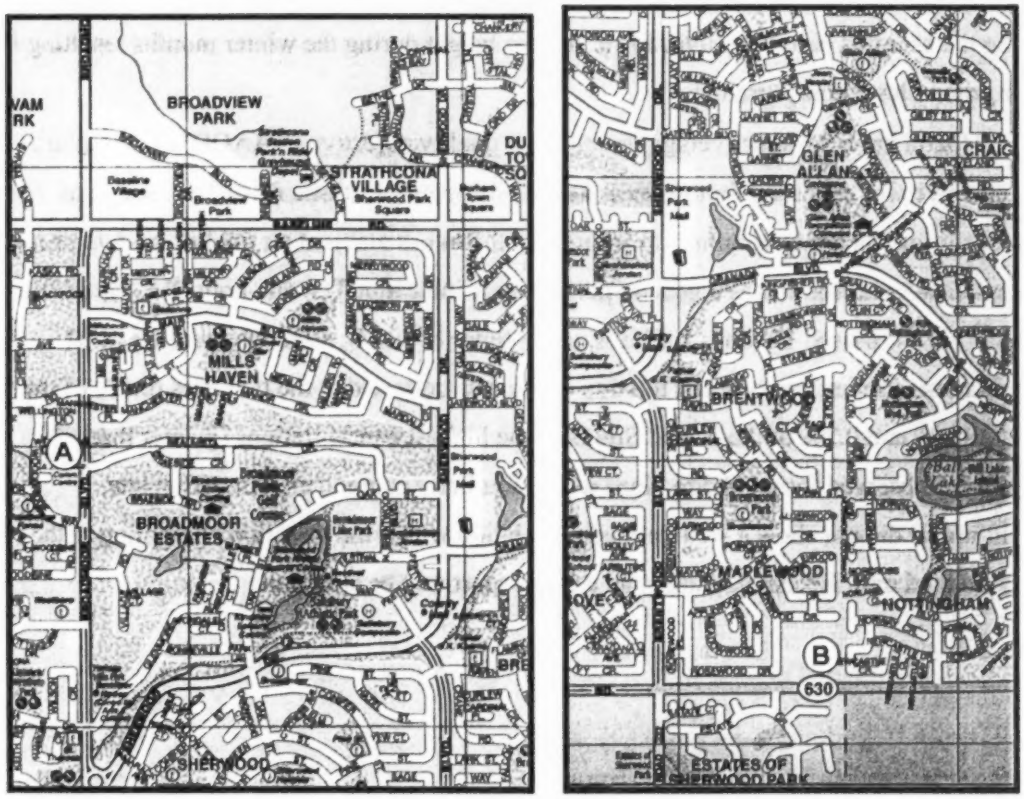

Figure 1: Map of sample sites. The base map for this figure was obtained from *Rand McNally 5th Edition Edmonton and Northern Alberta Communities.*

Preliminary Findings

Respirable particulates are fine particulate matter less than 2.5 μm in aerodynamic diameter; these particles are also referred to as $PM_{2.5}$. $PM_{2.5}$ are small enough to penetrate into the lungs. They may form in the atmosphere and/or be emitted by combustion sources such as vehicle exhaust, industrial emissions and wood burning. The data presented in this interim report were collected between January and June 2008. In addition to the presentation of the general $PM_{2.5}$ concentrations at the two sites, this preliminary examination of data looked for possible association between particle concentration and wind direction and speed as well as the sample month and day.

Descriptive statistics for $PM_{2.5}$ concentrations at the two monitoring sites are presented in Table 1. Overall, concentrations at the two sites were comparable with concentration ranging from below detection limit to 123 $\mu g/m^3$. Alberta has a 24-hour average[2] ambient air quality objective (AAAQO) of 30 $\mu g/m^3$. This objective was exceeded four times at Site A and once times at Site B. All exceedances occurred during the winter months. The one-hour $PM_{2.5}$ *guideline*[3] of 80 $\mu g/m^3$ was surpassed 12 times at Site A and 5 times at Site B. Preliminary results indicate that the frequency of elevated concentration at Site A was higher than Site B. However, these elevated concentrations formed a small fraction of the data collected at the two sites, 0.4% of the data at Site A and 0.2% of the data at Site B. At both sites, elevated concentrations were observed when the wind direction had a southerly component. At Site A, concentrations greater than 80 $\mu g/m^3$ were observed in January and February for periods of low wind speed (on average 2.8 km/hr). At Site B, elevated concentrations were observed during March and April; on average the wind speed at these times was 4.5 km/hr.

The median[4] concentration for each sample month is presented in Figure 2. $PM_{2.5}$ concentrations were higher during the winter months at the two Sherwood Park sites. This was likely due to atmospheric conditions that did not allow dispersion and/or greater amounts of semi-volatile material forming $PM_{2.5}$. Lower vertical mixing heights during the winter months can lead to the build up and increase of pollutant concentrations closer to the ground.

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[2] Averaged from midnight to midnight

[3] Alberta's air quality guidelines may be used to assess local concerns, as general performance indicators, and for Airshed planning and management.

[4] Definition of median is given in the appendix

Furthermore, semi-volatile compounds are more likely to condense onto particles during the colder winter months.

Table 1: $PM_{2.5}$ concentrations at Site A and B.

Concentration	Units	Site	
		A	B
Average	$\mu g/m^3$	11	9
25^{th} percentile	$\mu g/m^3$	3	3
50^{th} percentile	$\mu g/m^3$	7	7
75^{th} percentile	$\mu g/m^3$	13	13
90^{th} percentile	$\mu g/m^3$	34	29
Maximum	$\mu g/m^3$	123	123
Greater than 80 $\mu g/m^3$	count	12	5

Note:
A definition of percentiles is given in the appendix.

For comparison, Figure 2 also presents $PM_{2.5}$ concentrations at Edmonton Central and East monitoring stations. At the Edmonton monitoring stations, $PM_{2.5}$ is monitored using Tapered Element Oscillating Microbalance (TEOM) heated to 30°C. During the spring sample months (April – June), concentrations at the Edmonton monitoring stations are comparable to those in Sherwood Park. In the winter months however, there is a noticeable difference (especially for the sample collected in February). At these times concentrations measured at the Edmonton monitoring sites are lower. The lower winter $PM_{2.5}$ concentrations at the Edmonton sites may be due to sampling method. The TEOM samples were heated to 30°C, which may have resulted in full or partial evaporation of semi-volatile species that would have formed a portion of the total particulate matter during the colder sample months.

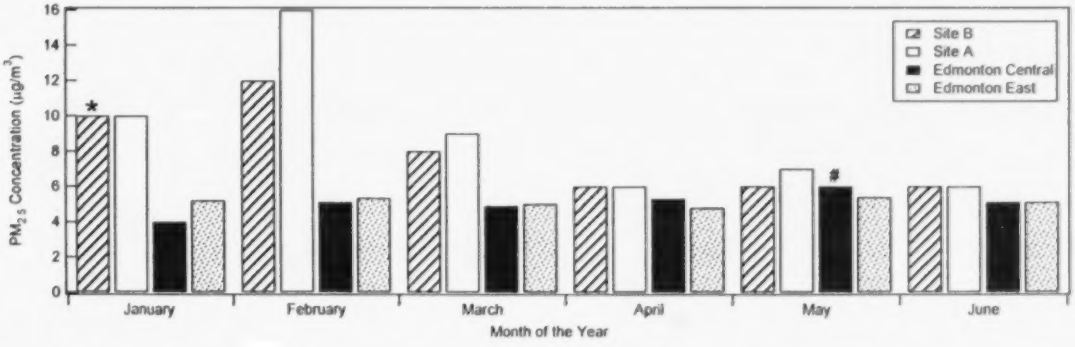

Figure 2: Monthly median $PM_{2.5}$ concentration for the two sample sites in Sherwood Park and two comparison stations. * indicates available data was 23% for this month at Site B. # indicates available data was 63% for this month Edmonton Central.

Particulate concentrations at Sites A and B were influenced by wind speed at these sites. The median concentration for various wind speeds are presented in Figure 3. The median concentration for periods when the wind speed was less than 3.6 km/hr are noticeably higher than for higher wind speeds. Higher concentration during periods of low wind speed is likely due to the limited dispersion of locally emitted particles.

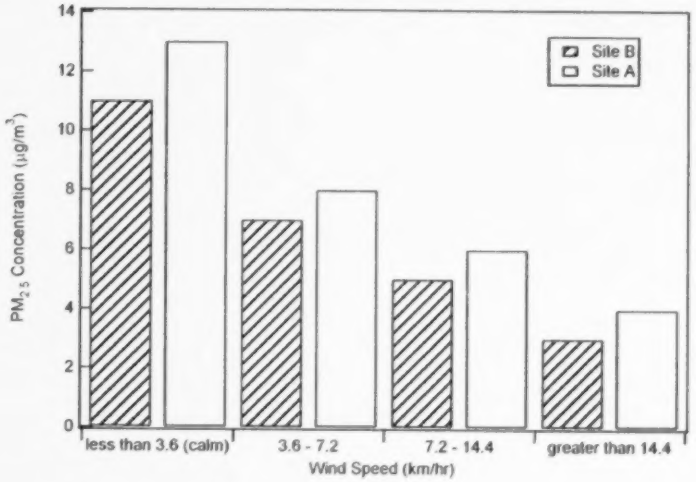

Figure 3: Median $PM_{2.5}$ concentration associated with wind speed at the monitoring sites. Calm conditions (wind speed less than 3.6 km/hr) appear to promote the build up of particulate matter at these sites.

Median concentrations for various wind directions are presented in Figure 4[5]. The median particulate concentrations were moderately higher for wind direction of north-northeast, east-southeast and southeast at monitoring Site B. At Site A, moderately high concentrations were noted for wind direction of east-southeast and northeast. More noticeable were the wind directions that corresponded with relatively low $PM_{2.5}$ concentration, namely west-north westerly for both Site A and B and easterly for Site B. The data presented in Figure 4 were collected when the wind speed was greater than or equal to 3.6 km/hr.

[5] Note that Figure 4 aims to identify general association between wind direction and overall concentration. As already discussed the highest concentrations were observed for wind direction with a southerly component. However, due to their low occurrence, such elevated concentrations would have minimal effect on the median concentrations used in Figure 4.

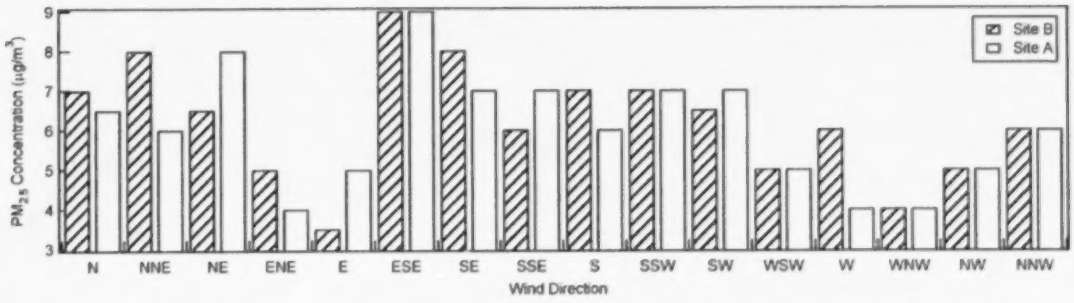

Figure 4: Median $PM_{2.5}$ concentrations associated with wind direction at the two monitoring sites in Sherwood Park. Data presented is for periods when the wind speed was greater than or equal to 1 m/s.

Median concentration for the day of the week is presented in Figure 5. Generally, for sample sites highly influenced by commercial motor vehicle emissions, particulate concentration sampled during the weekdays can be higher than those for the weekend. This was not observed at either of the two sample sites in Sherwood Park. In fact, median concentrations for Site A were marginally higher for samples collected on Saturday and Sunday.

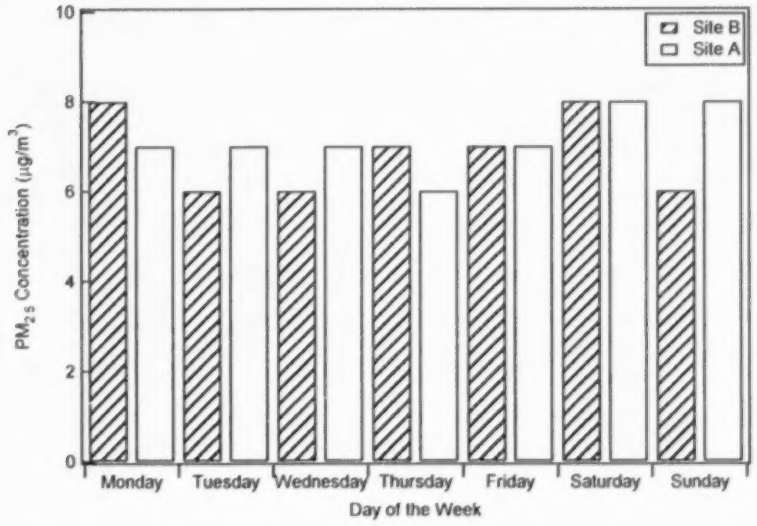

Figure 5: Median $PM_{2.5}$ concentration for each day of the week.

Appendix

The median concentration

The median concentration is a common way of representing the central value for environmental data. Most environmental data consist of a distribution that is skewed to the right; that is most data values are low and only a few are high. For such data sets, the arithmetic mean will be biased by the high concentrations; the resulting value may not be representative of the central value for the data set. For example, a data distribution consisting of five numbers: 1, 2, 2, 3 and 10. The arithmetic mean of these data is 3.6 and the median is 2. In this case, the arithmetic mean is biased high by the extreme value of 10. The median is the middlemost value in the data set; thus more representative of the central value of the data distribution. Fifty percent of the values in the dataset are below the median and fifty percent are above.

Percentiles

A percentile concentration is a value below which a certain percent of the observations fall. For example, 75th percentile particulate concentration at a site was 39 $\mu g/m^3$ indicates 75% (or ¾) of all the data collected at this site are below the indicated concentration. Percentiles provide additional information on the variation of concentration for a data set.